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Box PCT
Assistant Commissioner of Patents
Washington, D.C. 20231

Sir:

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Marked-up copy of the specification

LOCAL VIDEO AND AUDIO NETWORK WITH AN OPTICAL DATA LINE

BACKGROUND OF THE INVENTION

The invention relates to the field of automotive multimedia systems, and in particular to an automotive multimedia system that includes a local network with several subscribers who are connected together into a ring network by ~~means of~~ an optical data line, to transmit audio and/or video data as well as control data.

Local networks with several subscribers who are connected together into a ring network by ~~means of~~ an optical data line, to transmit audio and/or video data as well as control data are known, for example, from the European Patent Application EP 519 111 B1. This local network has several subscribers, some of which generate audio or video data and control data, and feed these into the ring network. These subscribers are called data sources. Other subscribers to the network receive ~~take~~ from the network the data intended for them, and then present the ~~cause these~~ data to a user ~~be displayed~~ either by acoustic or visual reproduction. These subscribers are often referred to as ~~so-called~~ data sinks. The known local networks have various data sources such as, for example, a car radio, CD player, DVD player, or ~~also~~ a TV tuner, which transmit their data uncompressed over the optical data line to the appropriate data sink, for example a car amplifier~~,~~ to which several loudspeakers are connected, or a screen which displays the uncompressed FBAS video signal. The subscribers to such a network input their data to the network independently of one another and thus sometimes simultaneously, and ~~likewise~~ withdraw the data in the same manner. Consequently, such a network can accommodate only a ~~very~~ few subscribers~~,~~ since the

transmission capacity of the network over the data line is limited.

~~Furthermore, i~~Individual devices are known, for example a television, which have a TV tuner and picture tube in a housing, and which are connected to one another via a data line. Uncompressed ~~The~~ video signals are transmitted ~~uncompressed~~ through this data line (e.g., ~~, for example~~ as FBAS signals), and are displayed on the picture tube. ~~But d~~Device combinations are also known, for example a DVD player ~~together~~ with a television set. With this combination, the compressed data stored on the digital video disk (DVD), which are coded, among other ways, according to the MPEG-2 standard, are read out, are decoded by an appropriate MPEG-2 decoder in the DVD player and thus are decompressed.~~,~~ The decompressed data are then ~~and are~~ transmitted as decompressed data over the connecting lines to the standardized television set. The television set reproduces/displays these decompressed data, for example as an FBAS signal, ~~by means of the picture tube,~~ in accordance with the video data received by the TV tuner.

A problem with the prior art systems is that the data on the data network are not compressed and thus inefficiently use the bandwidth of the data line and requires the data sources to provide decompressed data to the data sinks.

~~It is the object of the invention to create a local network, especially for automotive applications, which on the one hand better utilizes the maximum transmission capacity and at the same time is as economical as possible~~.

SUMMARY OF THE INVENTION

~~The invention achieves this object by a local network with the characteristics of Claim 1. Advantageous developments are specified in the subclaims.~~

Briefly, according to an aspect of the present invention, a motor vehicle optical ring

network includes an optical data line that defines a ring network, a playback transducer and at least one data source that is connected to the optical data line, and provides compressed data onto the optical data line. The network also includes at least one data sink that is connected to the optical data line, and receives the compressed data from the optical data bus and provides received compressed data indicative thereof. The data sink includes a bit stream decoder to decompress the received compressed data and provide a decompressed data signal indicative thereof to the playback transducer.

The inventive local network is ideally suited for automotive application. It transmits audio data and video data in compressed form via the data line, and it has a single bit stream decoder, centrally situated at the respective data sink, for decompressing the audio and video data conducted to it. This makes it possible to dispense with the decoders previously present at the various data sources, for example the bit stream decoder in the DVD player, which here is designed as an MPEG-2 decoder for the video data. For example, if several such data sources are to be arranged in a network, it is now possible to dispense with this plurality of bit stream decoders in the individual data sources and thus to reduce the costs of the network with its subscribers. Only at the relevant data sink is a single bit stream decoder present for decompressing the corresponding video data or ~~also~~ audio data., ~~, so that typically the decoder components, which are very expensive and cost-intensive integrated circuits, are reduced to the absolutely necessary minimum.~~ As a result of this new realization, the individual components (~~,~~ i.e., the data sources)~~,~~ can now make do without their own bit stream decoder for decompressing the data. By the assignment of such a bit stream decoder centrally to the relevant data sink, the components of the individual subscribers are distributed in a new and better way in the network. Advantageously, ~~On the one hand,~~ this

better utilizes the available data transmission capacity of the network, due to the transmission of compressed data instead of decompressed data. In addition, ~~; on the other hand,~~ it greatly reduces the overall costs of the network. The various data sources ~~always~~ can be implemented more economically at the expense of the data sinks, since the data sources can dispense with the cost-intensive bit stream decoders. Since an inventive local network regularly has a much larger number of data sources than data sinks, this results in the above-mentioned marked cost reduction.

In ~~According to~~ a preferred embodiment, the data sink with its bit stream decoder is designed separate from the data sources ~~sinks~~, ~~as a result of which all~~ and the compressed audio or video data are conducted to the data sink via the optical data line. This ~~greatly~~ reduces the circuit complexity of the data sink, ~~thus~~ further reducing the costs of a network with such a data sink. This also ~~assures~~ ensures that all the compressed data conducted to the data sink are treated equally, and that no parallel inputted audio or video data are treated preferentially.

~~An especially beneficial design of the invention makes it possible that~~ The data connection between the data sources and the data sink with the bit stream decoder can be controlled by ~~means of~~ control data transmitted over the data line. This ~~assures~~ ensures reliable establishment of the data connections, the assignment of the data sink to the data sources, as well as control of the type of decompression. ~~It has proven especially beneficial to switch t~~The bit stream decoder may be switched between several modes of decoding ~~function~~ by ~~means of~~ the transmitted control data. This allows ~~In this way,~~ a single bit stream decoder to ~~can~~ read several compressed data formats, and an appropriate switched state of the bit stream decoder can be chosen as needed (~~,~~ i.e., depending on the compressed data format used by the data source)~~, and the data in this compressed data format can be correctly decompressed with the chosen decoding function~~. ~~It has proven beneficial to provide a~~The decoder may support ~~for~~ video data compression formats such as ~~which~~

~~typically comprise the~~ MPEG-1, ~~format, the~~ MPEG-2, ~~format, and also the~~ and JPEG. ~~format. Correspondingly, a~~Another bit stream decoder can be ~~can also be~~ switched to ~~for~~ decompress~~ing~~ various audio compression formats (e.g., AC-3, MPEG-1, and MPEG-2). This can further reduce the number of required bit stream decoders. It has proven beneficial to dispense with a collection of decoders for compressed audio data and for compressed video data, since the compression methods used therein as well as the data structures for the audio and video data are too different, and the audio bit stream decoders and video bit stream decoders can be collected together only with very sophisticated organization and ~~therefore~~ cost, which would by far cancel the theoretical cost advantage of further decoder reduction.

BRIEF DESCRIPTION OF THE DRAWING

The FIGURE illustrates a block diagram illustration of a local video and audio network with an optical data line.

DETAILED DESCRIPTION OF THE INVENTION

~~A preferred embodiment of the invention is shown in Figure 1 and will be explained in more detail below.~~

~~The~~ A local network 100 includes a plurality of ~~has four~~ subscribers 1~~-4, 2, 3, 4,~~ that ~~which~~ are connected to one another in a ring by an optical data line 5. Each of the subscribers 1~~-4, 2, 3, 4~~ includes an associated ~~has an~~ interface 4-1, 4-2, 4-3, 4-4, ~~with~~ respectively, and each interfaces includes two connections to the optical data line 5 to establish the ring.

Subscriber 1 is a car radio and forms a data source. This data source 1 receives a radio signal and delivers this either as uncompressed audio data~~,~~ via its interface 4-1~~,~~ to the data line 5

and thus to the network for transmission to the associated data sink, or the audio signals of the radio program are conducted to an integrated bit stream encoder 10, which converts the audio signals into compressed audio data and transmits them, via the interface 4-1, to the optical data line 5. The AC-3 format is ~~has turned out to be~~ a suitable coding format for the audio signals.

Along with ~~Besides~~ the audio data from ~~of~~ the car radio 1, control data are also transmitted over the optical data line 5, which ~~assures~~ ensures the correct assignment of the audio data to the correct data sink (e.g., ~~, namely~~ subscriber 3). In addition, an appropriate control signal ~~assures~~ ensures that the data sink 3 conducts the incoming data, inasmuch as these are transmitted as AC-3 compressed data, to the corresponding AC-3 bit stream decoder, which ~~accomplishes~~ decompresses~~ion of~~ the data. If the audio data ~~are~~ transmitted ~~uncompressed~~ by the car radio 1 to the data sink 3 are not compressed, the bit stream decoder 6 will not be activated to decompress the audio data~~function~~.

The data sink 3 contains an audio amplifier, which is connected via the ~~an~~ interface 4-3 to the optical data line 5, and which obtains the audio data directed to it from this data line 5. Depending on the control data transmitted ~~together~~ with the audio data, the audio data may also be ~~are further~~ processed in the amplifier 3. For example, this processing includes equalization, application of a delay, or signal amplification, which are enabled/disabled ~~all these processes being controlled~~ by the control signals transmitted over the network. In the present example, ~~therefore,~~ audio data compressed in the AC-3 format are transmitted by the car radio 1~~,~~ via the optical data line 5~~,~~ through the subscriber 2~~,~~ to the amplifier 3, and there are decoded and ~~thus~~ decompressed by the AC-3 bit stream decoder 6-3. Subsequently, they are, among other things, amplified, and then are conducted to the loudspeakers 9, which are connected to the amplifier 3, of which two units are shown by way of example.

In addition to ~~Besides~~ the car radio 1, the local network 100 may include ~~there is~~ a second data source 2 such as ~~, namely~~ a DVD player. This DVD player reads ~~can take~~ from ~~the~~ a DVD both audio and video data in compressed form, and outputs ~~can places these~~ the compressed audio and video data onto the data line 5 via ~~without any further processing in the sense of decompression on~~ its interface 4-2.~~, to be conducted to the data line 5. This clearly shows that~~ Significantly, the DVD player 2 can dispense with any kind of bit stream decoder because, on the one hand, the audio and video data are to be transmitted in compressed form over the data line 5 and, on the other hand, an appropriate decoder is situated centrally in the data sinks 3, 4 to play back the audio and video data. Thus, the DVD player 2 can dispense with the expensive integrated circuits to decode the audio data, which here are present in the AC-3 format, and the video data, which here are present as MPEG-2 data. This is directly reflected in the form of a markedly reduced price for the DVD player.

The ~~unchanged~~ compressed audio and video data of the DVD player 2 are sent to the appropriate data sinks, which can be, on the one hand, the amplifier 3 described above and, on the other hand also the display screen unit 4. Only the display screen unit 4 needs to be considered as a data sink for video data. The unit 4 includes ~~It has~~ an interface 4-4, through which it is connected to the data line 4 5 on its input and output side, ~~further~~ an MPEG-2 decoder 6-4~~, which~~ that decodes and thus decompresses the MPEG-2 coded video data transmitted to the display screen unit 4, and, for example, makes ~~them~~ available ~~as~~ uncompressed RGB signals to the ~~TFT~~ display (e.g., a TFT) for playing back the video data. ~~Furthermore, t~~The display screen unit 4 includes ~~has~~ a control unit 7, which on the one hand controls the display screen unit 4~~,~~ by controlling the video data reproduction on the screen 8 ~~as regards~~ (e.g., its brightness, contrast, and hue~~,~~) and on the other hand ~~also~~ adapts the function of the bit stream decoder 6-4 to the format

of the inputted video data. In this way, on the one hand the bit stream decoder can be turned off if non-coded video data are transmitted, or, on the other hand, an appropriate decoding function of the bit stream decoder can be chosen, in accordance with the incoming format (e.g., ~~, for example,~~ MPEG-1, MPEG-2, or the JPEG format). For example, MPEG-2 decoders can readily function as MPEG-1 decoders.

The control 7 not only can control the display screen unit 4, but can also control the local network and particularly the data channels for transmitting the audio and/or video data between the particular data sources and the particular data sink.

Depending on the control 7, the compressed audio data from the DVD player 2 are conducted via the optical data line 5 ~~either~~ to the amplifier 3 or to the display screen unit 4, which has integrated loudspeakers in its display screen unit housing. By way of example, we shall assume that the control 7 has set an acoustic playback of the audio data through the amplifier unit 3. In this case, the compressed audio data are received via the optical data line 5 by the interface 4-3 of the amplifier 3, are conducted to the AC-3 bit stream decoder 6-3, which decodes and decompresses the compressed audio data and then conducts the uncompressed audio data to the amplifier stage of the amplifier 3. After the audio signals have been amplified, they are conducted to the loudspeakers 9.

This local network therefore shows how the data sources 1, 2 ~~can dispense with any bit~~ no longer require a stream decoder ~~whatsoever~~, and how the bit stream decoders 6-3, 6-4 are assigned to the data sinks 3, 4, which are centrally responsible for playing back the audio or video data. The example of the amplifier 3 clearly shows that it contains an AC-3 decoder 6-3 to decode the compressed audio data from the DVD player 2 and also from the car radio 1, and that these decoded audio data subsequently are reproduced by ~~means of~~ the loudspeakers 9. Through this

centralization and assignment of the bit stream decoders 6-3, 6-4 to the data sinks, the number of decoders can be greatly reduced. On the one hand, this noticeably reduces the costs of such a network even with a small number of subscribers. With a large number of subscribers, especially with an increasing number of data sources 1, 2, the achievable cost advantage becomes continuously greater.

Furthermore, this local network exhibits the possibility of much more efficiently utilizing the maximum transmission capacity of the optical data line 5, since now many more parallel data channels can be transmitted simultaneously. Through this combination of improving the transmission efficiency together with a marked cost reduction, an especially advantageous local network has been created.

Such a network is especially suited for use in an automobile, since in this application electromagnetic compatibility (e.g., optical data line 5), ease of installation (e.g., a single data line 5), and very low costs (e.g., reduction of the necessary bit stream decoders) with the same or greater functionality of the network are especially important. This increased functionality becomes especially clear with the simultaneous transmission of several video data channels, since these have enormous data quantities. It should also be noted that it is precisely video applications which are becoming more and more important in automobiles, and consequently special attention must be paid to transmission efficiency together with adequate reliability for automotive use.

What is claimed is:

~~List of Reference Symbols~~

~~1 Subscriber, data source, car radio~~

~~2 Subscriber, data source, DVD player~~

~~3 Subscriber, data sink, amplifier~~

~~4 Subscriber, data sink, display screen unit~~

~~4-1 Interface~~

~~4-2 Interface~~

~~4-3 Interface~~

~~4-4 Interface~~

~~5 Optical data line~~

~~6-3 AC-3 decoder of the amplifier 3~~

~~6-4 Bit stream decoder of the display screen unit 4~~

~~7 Control~~

~~8 Screen~~

~~9 Loudspeaker~~

~~10 AC-3 encoder~~